INVESTIGATIVE REPORT
MARVIN FIRE

Marvin Fire

NOVEMBER 12, 2005

VIRGINIA DEPARTMENT OF FORESTRY

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In Memory of Chief Max Willard
Oakwood Volunteer Fire Department

Photo by Chris & Thelma Smith

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Executive Summary

On November 12, 2005 at approximately 1:30 p.m., Oakwood Volunteer Fire Department Chief Max Willard, age 69, was killed in a wildfire blow-up in a steep draw on the Marvin Fire near Marvin, Virginia in Buchanan County.

Willard, a 25-year veteran of the volunteer fire service, was the first resource on scene and immediately began constructing a fire break in front of the fire's head using a fire rake. The fire quickly increased in intensity and crossed the fire break below Willard forcing him to retreat up a very steep drainage for about 1400 feet to where he was overrun.

The Marvin Fire started about 12:15pm EST on Saturday, November 12, 2005 as the result of a lawnmower catching fire and spreading to the woods. The fire was contained about 6:00 am EST on November 14th at 433 acres. The fuel type was loosely compacted hardwood leaf litter with depths of about 6 – 12 inches. The slope where the entrapment occurred exceeded 50 % and fire scarring of the trees in this location exceeded 20 feet.

Factors contributing to this incident include:

1. The incident occurred in a chimney-like, very steep, south-facing drainage.
2. The area was under an extended drought.
3. The incident occurred during exceptionally low relative humidities and high winds.
4. LCES rules were compromised in an effort to aggressively begin suppression actions.

With respect to the significant causal factors of the fatality, the incident review provides the following recommendations:

1. The Department of Forestry increase the frequency and number of local volunteer fire department trainings - with an emphasis on fire suppression tactics and safety - including LCES and the 18 watch-out situations.
2. The Department of Forestry switches to regionally specific radio programming, rather than a single statewide standard, to allow the incorporation of more local VFD and cooperator radio frequencies to provide better incident communications.
3. The Department of Forestry must work in Unified Command with the Chief or other officer in charge where Fire Departments have jurisdictional responsibility for the protection of structures. This will emphasize the safety of all firefighters and the public, ensure coordination of objectives, and maximize communications between the DOF and Fire Departments.

MARVIN FIRE NARRATIVE

The Marvin Fire was initially reported shortly after noon on Saturday, November 12, 2005 by landowner Louis Addison. Mr. Addison lives just off Route 460 and near Route 618 in the community of Marvin in Buchanan County, Virginia. Mr. Addison's lawnmower had malfunctioned and caught fire and quickly ignited leaves in a ditch along his driveway. The County Dispatch dispatched the Oakwood Volunteer Fire Department, and they arrived on the scene initially with one engine. Chief Max Willard was driving the engine and had no other firefighters with him during the initial dispatch. However, another firefighter had arrived on the scene to assist with any suppression action. Chief Willard made a quick size-up and decided to protect a threatened structure (Jim Cook's house) by raking between the left flank of the fire and a propane tank near the structure. Shortly after raking a small section of line by the propane tank, Chief Willard instructed the firefighter with him to assist other members of Oakwood Fire Department with laying a hose line around the structure. The Chief continued alone to build fire-line uphill on the left flank of the fire behind the structure. This was the last time anyone saw or heard from Chief Willard until his body was found early the next morning.

More fire apparatus arrived from Oakwood VFD as well as other Fire Departments in the County. Fire Departments concentrated their efforts on structure protection along Route 460. Virginia Department of Forestry personnel arrived early in the afternoon and begun size-up of the wildland portion of the fire to determine suppression efforts to contain the forward progress of the fire. Numerous gas wells and lines, slopes, and fire behavior, initially hampered suppression efforts.

Later on Saturday afternoon, more structures were beginning to be threatened along Nine Mile Road as the fire made runs up the slopes and jumped across the numerous gas well access roads within the fire area. Wildland efforts were then concentrated more on structure protection along Nine Mile Road. DOF fire crewmembers used leaf blowers and fire-rakes to construct lines behind homes and then burn out from the constructed lines. As protection along Nine Mile Road was completed, fire crew personnel worked on structure protection behind a section of houses along the eastern flank of the fire near Route 460.

During Saturday night the fire crew and fire departments worked on more structure protection going westward from the fire origin along Route 460. The DOF fire plow was used where slopes would allow constructing control lines. Structure protection continued until sometime on Sunday morning and then efforts were concentrated again on completing control lines where needed to contain the fire. By this time, there were numerous "heads" to the fire to be concerned with.

Various Fire & Rescue personnel were organized between 6:00 to 6:30 a.m. on Sunday morning to search for Oakwood Fire Department Fire Chief Max Willard. He had not been seen or heard from since his initial attack efforts around the propane tank early on Saturday afternoon. Efforts had been made by Oakwood Fire Department on Saturday to locate Chief Willard by checking along gas well access roads, but still no sightings had been made. Chief Willard's body was found around 8:30 to 9:00 a.m. about 185 feet from the top of the slope. His body had been burned over by the fire. Indications are that the fire got below Chief Willard, and he was unable to escape as the fire traveled rapidly up slope.

DOF replacement personnel started arriving early on Sunday afternoon including a new Incident Commander. Size-up continued and decisions were made where to locate lines. Control lines were begun on the east end of the fire near Clifton Fork Road to minimize impact on gas wells and lines. Hand line construction was started at the top of the ridge and continued down to an access road at the bottom. This line was almost completed when

it began to rain. As the slope became more unsafe, firefighters were pulled off the lines, and suppression efforts were curtailed for the night.

On Monday, November 14, 2005 fire crews completed all remaining control lines needed on the northern most area of the fire plus a small amount of line not completed from the evening before prior to the rain. Lines were mopped up including some snag work. Damp conditions did not allow for any burning out of control lines. The fire was declared contained and controlled late Monday afternoon.

CHRONOLOGICAL SEQUENCE OF EVENTS

Saturday- November 12, 2005:

11:30-12:15 p.m. The Marvin Fire began in this time period & was consequently reported by Landowner Louis Addison to the Buchanan County Fire & Rescue Dispatcher. The fire origin is located just north of Route 460 and west of Route 618 near the community of Marvin in Buchanan County, Virginia. The fire was caused from Mr. Addison's lawnmower that malfunctioned and caught on fire as Mr. Addison was driving the lawnmower down his driveway. He jumped off the mower after it caught fire, and the mower rolled into the ditch adjoining his driveway. Leaves in the ditch caught fire and the fire spread up the bank and into adjoining woodland. The fire quickly threatened Mr. Addison's house and the adjoining home of Jim & Betty Cook.

12:15 -12:45 p.m. County Fire & Rescue Dispatcher dispatched Oakwood Volunteer Fire Department to the wildfire. Oakwood VFD Fire Chief Max Willard responded alone with an engine. Chief Willard arrived at the scene and parked his engine at the bottom of Landowner Addison's driveway. Firefighter Adam Clifton from Patterson FD was driving by and stopped to help fight the fire. Chief Willard climbed on the engine and gave Firefighter Clifton a fire rake and also took a garden rake from the engine. A passing newspaper reporter on Route 460, Earl Cole, with "The Voice" newspaper took a photo of Chief Willard and the firefighter taking rakes off the back of the Oakwood FD engine. Quickly sizing up the situation, Chief Willard chose to protect Jim Cook's resident first by beginning a rake line between the left flank of the fire and a propane tank on the edge of Jim Cook's yard. During this time frame, Betty Smith and a friend, Muriel Woods, began attempting to also protect the Cook residence by squirting water near the propane tank. The Cooks' have a small hydrant and a hose located to the front of their property next to Rt. 460. Mrs. Woods was traveling on Rt. 460, & had stopped by to inform Betty Cook of the fire close to their property.

12:45-1:30 p.m. Patterson VFD, Whitewood VFD, & Buchanan County Sheriff's Department were dispatched to Marvin Fire. Dispatch also tried to contact the Virginia Department of Forestry personnel listed for Buchanan County, but were told they had been dispatched to a fire in Dickenson County. The Sheriff's Department at the scene advised dispatch that two houses were currently threatened by the fire. The Department of Forestry Fire Crew (Vansant Crew) then called back & advised Dispatch they would be in route to the Marvin fire from Dickenson County.

Oakwood FD Assistant Chief Stanley Smith responded alone with their crash truck & parked in the driveway next to the engine Max Willard responded with. Stanley Smith saw Chief Willard and another firefighter raking fire lines in the woods close to the propane tank, and saw homeowners with the hose in Jim Cook's yard. Deciding that structure protection was adequate at the Cook residence, Stanley Smith then got in the Oakwood engine parked at the scene and drove up the driveway to protect Louis Addison's house. Shortly after this, Chief

Willard told Firefighter Adam Clifton to help Patterson Fire Department with the placement of hose lines behind the residence. Chief Willard then left Firefighter Clifton and continued uphill along the edge of the fire. This was the last time Adam Clifton or anyone else saw Chief Willard. There is no evidence that Chief Willard carried a portable radio or other means of communication with him or had any personal protective gear other than possibly gloves. It appears from "burn indicators" on trees & other vegetation and the severe fire behavior that the fire got below Chief Willard on the slope and burned him before he could escape from the approaching fire front. Refer to more specifics in the "Fuels and Fire Behavior Assessment" portion of this "Fatality Case Report".

Patterson VFD & Whitewood VFD's arrived on scene and began structure protection around threatened homes.

1:30-3:30 p.m. Dan Gates (Crew Boss) and DOF Vansant Fire Crew arrived on fire scene. Dan Gates along with Johnnie Sparks of the DOF Crew determined that Fire Departments were handling structure protection along Route 460. The decision was made for the Vansant Fire Crew to locate the head of the fire and begin control work to try & stop the forward progress of the fire. The Fire Crew proceeded into area to the north of the origin. The area contains old mines and numerous active gas wells along with many roads used in the maintenance of these wells. The fire was moving rapidly away from Route 460 and the fire kept spotting across the interior roads and trails making decisions to specifically locate and begin control lines extremely difficult. No control work was done during this time frame as the fire continued to burn rapidly and spread uncontrollably up and across drainages & spot across the interior roads. In addition, gas wells were being ignited and safety of firefighters was the number one priority of the size-up process. A second fire was reported near Clifton Fork early in this time frame, so Whiteville, Patterson, and Oakwood Fire Departments units were also dispatched to the Clifton Fork Fire. David Richert, DOF Tazewell Forester, along with a few DOF crew members were also dispatched to the Clifton Fork Fire later on in the afternoon.

3:30- 4:30 p.m. Scott Ward, DOF Tazewell County Technician, arrived at the origin of the fire along with the tractor fire plow unit from Tazewell. Scott talked with Whitewood VFD about the fire, and it was determined that the Fire Departments were currently able to handle structure protection, and that DOF should continue to assess and take control action on the woodland. Scott Ward assumed position of Incident Commander in Unified Command with Fire Departments. Scott and the dozer unit then met up with Johnny Sparks to proceed to the top of the ridge to work on suppression of the head of the fire.

4:30 p.m. - 6:00 p.m. Scott Ward and the Fire Crew proceeded north up Nine Mile Road which tied into service roads to the gas wells. "It was difficult to navigate once we were at the top of the ridge due to heavy vehicle traffic and few turnouts". The fire with 10-25 ft. flame lengths was jumping the service roads too quickly to construct any type of hand line. Several hydro seeders manned by CNX gas company crew were spraying water on the approaching fire causing it to create fingers and continue to burn upslope. The left flank of the fire soon threatened to burn several houses and structures along Nine Mile Road, and protecting these structures became the immediate priority of the Fire Crew, and efforts were begun to begin line construction and burn out to protect the structures.

6:00 p.m. - 9:00 p.m. Hand line construction was begun anchoring into a gas line service road on top of the ridge near well 22. Line construction continued during this time toward the intersection of Nine Mile Road & Route 460 to protect the structures along Nine Mile Road. The Vansant Crew cleared the fire lines, fired from the lines as they proceeded, and crew members monitored the lines as needed. CNX gas company employees continued to monitor & protect their gas wells in the area.

9:00 p.m.-10:00 p.m. Scott Ward called DOF Abingdon Dispatch and asked for additional resources for the fire. There were none currently available due to the high number of fire occurrences in the region that day. Requests were made for replacement personnel and crews for the following day. Scott also asked DOF Dispatch to have Oakwood & Grundy VFD's respond to help with structure protection along Nine Mile Road. DOF Crew took rest and food break and Scott Ward discussed tactics with crew to continue defending houses along Nine Mile Road & Route 460.

10:00 p.m. - 12:00 a.m. Scott Ward left three fighters to continue protecting two structures on Nine Mile Road. These crew members began line construction using fire line blowers behind the homes & then burn from these lines as the fire was slowly creeping back down the slope towards Nine Mile Road and Rt. 460. The remaining crew members went with Scott Ward to assess needs along 460.

Sunday- November 13, 2005:

12:00 a.m. - 2:30 a.m. DOF Fire Crew went east on Route 460 and determined the fire was backing quickly down towards 460 along the eastern boundary of the fire. Approximately 15 residences were threatened, and so decision made to control this flank next. Hand line construction was begun on the right flank of the fire and & then burned out. This line was conveniently located in a dry stream channel in a small hollow. This line was quickly contained as some work had already been done by the homeowners in the area. Scott Ward and crew then headed back west on Rt. 460 to protect other structures as the fire backed down towards the road.

2:30 a.m. - 4:00 a.m. Scott Ward and crew located a structure along Route 460 that the fire was backing down the slopes within 50 yards of the residence. Oakwood VDF had trucks at the scene and the crew constructed lines around the structure and fired the lines. This operation took a time as the slope behind the house was steep and there was vegetation right next to the house plus old cars & a junk pile that had to be navigated around with the fire lines. The DOF fire plow unit and fire department units then proceeded to the next group of 6 trailers a few hundred feet West on Rt. 460 for structure protection.

4:00 a.m. - 6:00 a.m. The DOF dozer pushed lines along where old Rt. 460 was located behind the 6 trailers and the DOF Fire Crew fired from these lines. This area above the fire lines burned quickly as large wind gusts and thick kudzu aided the fired lines burn into the main fire creeping down slope. Fire Departments continued to support this operation and use water where needed. The portion of the DOF Fire Crew left on Nine Mile Road met up with Scott Ward and Fire Crew on Rt. 460, and the next structure along Rt. 460 going west was protected by dozed lines and then fired.

6:00 a.m.-8:00 a.m. Fire & Rescue personnel began formal search for Oakwood Fire Department Chief Max Willard.

Two more houses along Route 460 were protected using dozed lines where possible and then hand lines where needed. Lines were fired as Oakwood Fire Department monitored to make sure fire did not cross control lines. Higher humidity somewhat hampered firing efforts, but eventually fired lines tied together with previously fired lines and the wildfire without any suppression needs from spot-overs.

8:00 a.m. - 8:30 a.m. Scott Ward called Steve Counts at DOF Dispatch and asked for the Detention Crew at Honaker to be contacted and dispatched to the Marvin Fire. Dispatch called back & informed Scott that the crew was unavailable because a Department of Corrections Guard required for the crew was not available. Steve Counts did inform Scott that two full-time personnel were plus crew members were on their way to help. The fire was estimated at 250 acres at this time.

8:30 a.m. - 9:30 a.m. Fire Chief Max Willard's body was found 294 feet from the top of the ridge and the gas line access road. A garden rake assumed to be Chief Willard's' was located later 109 feet 5 inches from the body and closer to the top of the ridge. The garden rake handle was burned into two pieces. It appears Chief Willard made it to within 185 feet of safety at the top of the ridge, but then left the garden rake while attempting to return down slope from the ridge top.

The last house on Route 460 needing protection was worked on by the Fire Crew. Lines were cleared using leaf blowers and then the lines were fired. According to Scott Ward, the sun had come out and the firing operation went a little quicker than earlier in the morning before the sun had come up when humidity levels were at their maximum for the night. Once this structure was secure, the Fire Crew & Scott Ward headed to the top of the ridge to size-up the fire at that time.

9:30 a.m. - 12:30 p.m. Scott Ward & Fire Crew continued to size up fire and determine strategy and tactics. David Richert, DOF Tazewell Area Forester, met up with crew. He had been on the Clifton Fork Fire and now could help with the Marvin Fire. CNX gas company personnel were consulted concerning the gas wells. The gas company advised Scott Ward not to back fire anything at the top of the ridge as there were numerous active wells. They also advised not using the dozer because of many underground gas lines. This made strategy and tactics even more difficult with these restrictions in the area. Gas company personnel did give Scott a map of the area with the location of gas wells which was helpful. The Vansant Fire Crew was released during this time as they had been working for 24 hours.

12:30 p.m. - 3:00 p.m. Full-time DOF personnel, Riley Bruce & Donnie Garman arrived at scene plus a couple of part-time personnel. David Richert & Donnie rode to the Clifton Fork Fire to check on the status of that fire. Riley Bruce was briefed by Scott Ward on the Marvin Fire while looking at the area & discussing strategy & tactics. Steve Counts from the DOF Region 6 Office flew over the fire and advised where possible control lines could be constructed. Gas Company personnel were again met with to discuss using the dozer and firing lines in certain areas. Scott Ward & David Richert had reached their 24-hour work limit, so they left the fire with instructions from DOF Dispatch to return to the fire Monday morning. Riley Bruce assumed position of Incident Commander for the DOF on the Marvin Fire.

3:00 p.m. - 5:00 p.m. Riley Bruce and Donnie Garman continued to size-up fire and get organized to begin more control lines. Status of all structures was evaluated and all deemed currently protected. After looking at all possibilities, the highest priority was determined to be control lines on the east end of the fire near Clifton Fork Road (Rt. 629) to minimize impact on gas wells and lines.

5:00 p.m.-11:30 p.m. Line construction was begun at the top of the ridge on the east side of the fire and continuing down to an access road at the bottom. This was another hand line as it was deemed too steep & rough for a dozer line. Towards the end of this period, it began to rain, and it was decided to curtail all operations for the rest of the night because of slippery and unsafe conditions. All firefighters were pulled off the lines and sent home or to their motel.

Monday- November 14, 2005:

8:00 a.m. - 12:00 p.m. David Tolliver, DOF Technician for Buchanan County, assumed command. After size-up, briefing, and checking status of all structures and lines, it was determined the only lines needed were in the northern most area of the fire plus a little line work on the far eastern right flank line near Clifton Fork Road previously constructed prior to the rain. The Vansant Fire Crew completed the line from the evening before. The Honaker Detention Crew completed a short section of the remaining line on the north end of the fire, and the USFS Augusta Hot-Shot Crew completed the remainder lines needed. Moist conditions precluded any burning out.

12:00 p.m.-17:00 p.m. Vansant Fire Crew put short section of direct line to hold area which had not burned out adjacent the road on the right flank above Rt. 460. The crew also worked a few snags and mop-up adjacent to one of the gas well roads. Fire was declared controlled at approximately 433 acres at the end of this period.

Marvin Fire
Fuels and Fire Behavior Assessment

Background

On Saturday, November 12, 2005, a wildland fire occurred on private land near the small community of Marvin, Virginia. According to witnesses, the fire began between approximately 1100 and 1200, the result of a riding lawnmower catching fire at a private residence along Highway 460. The fire began near the residence of the landowner and spread rapidly uphill onto steep terrain. In addition, several other private homes and associated capital facilities were threatened. Several local volunteer fire departments responded initially to the fire, including the Oakwood Volunteer Fire Department. The Chief of the department, Max Willard, was among the first responders to arrive on the scene. According to testimony given to investigators, Chief Willard deployed fire department resources in initial attack activities protecting homes near the origin of the fire. In the interim, Chief Willard scouted upslope, apparently on his own with no communications, with the intent to size-up fire activity and gather information about what could be done tactically to bring the fire under control. Chief Willard was not heard from or seen again until his body was found on Sunday morning, November 13th. The circumstances surrounding his death are unknown. However, the location and physical condition of the body suggests that he was involved in fire suppression activity near the head of the fire on the steep slopes located above the initial ignition point (figure 1).

Figure 1

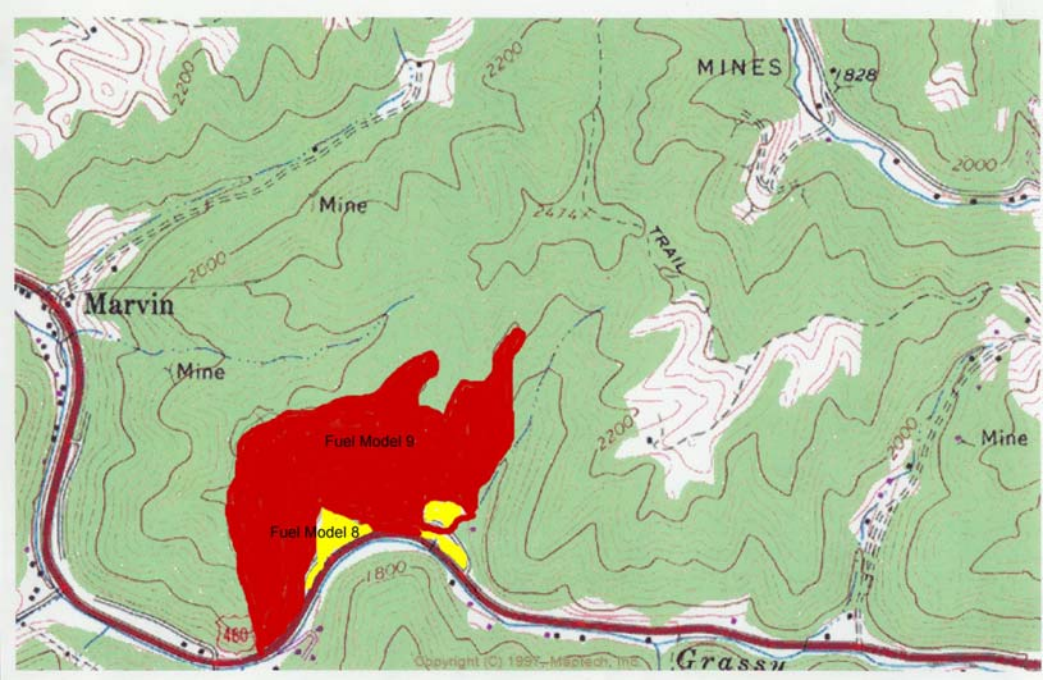
As a result of the fatality, the Virginia Department of Forestry, the agency that has overall fire protection responsibility for wildland fires on private lands, requested an assessment of wildland fire fuels and fire behavior for the initial stages of the fire on the date in which it occurred. On January 11-12, 2006, Virginia Department of Forestry employee Larry Cochran accompanied me to the site of the fire. We conducted a visual assessment of fuels and probable fire behavior based upon personal observations and written descriptions of the fire from participants in the fire suppression effort. In addition, the National Weather Service and the U.S. Forest Service provided general fire weather and National Fire Danger Rating System (NFDRS) records for the date(s) of the fire. The availability of this information was particularly important since no known on-site weather or fire behavior observations were taken on-site during the fire.

The primary focus of this analysis is with the area immediately surrounding the origin of the fire (first 1-3 hours of fire activity) and the physical surroundings adjacent to the location where the fatality occurred. Extended attack operations were *not* considered as a part of the analysis.

Fuels

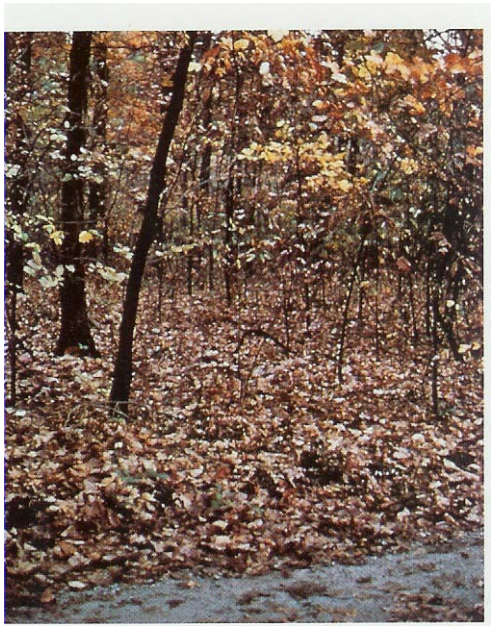
Fuels in the fire area are relatively homogeneous and are classified as hardwood leaf litter, NFFL fuel models 8 and 9. The attached fuel model map (figure 2) shows the locations of fuel models 9 and 8. For both fuel models, fuel loading was found to be relatively light (<12 tons/acre for FM 9 and <7 tons/acre for FM 8). The primary fuel found was hardwood leaf litter (1-hr timelag fuel). The presence of 10-hr (1/4 – 1 in diameter), 100-hr (1-3 in diameter), and 1000-hr (3 in>) fuels was far less than expected. Although some brush fuels (rhododendron and mountain laurel) were present, their impact on fire behavior was negligible due to the scarcity of fuel loading in these fuel types. Due to the drought conditions in evidence at the time of the fire, these fuels would normally have been expected to exert a significant influence upon fire behavior, since live fuel moistures in these species were very low.

Figure 2



The majority of the fire area is populated by species that contribute significantly to fire behavior as represented by NFFL fuel model 9 (figure 3). Particularly on upper slopes, quantities of chestnut oak, hickory, red oak, and

Figure 3



mixed hardwood species provide ample quantities of fine fuel in the form of hardwood leaf litter, the primary carrier of fire in this assessment. At the time of the fire, these leaves were very dry and "fluffy", having recently fallen from the overhead tree canopy.

Fuels classified as fuel model 8, are predominantly found on lower slopes just north of one of the residences situated along highway 460. These fuels are represented by the leaf litter from vegetation characterized primarily by the cove hardwood vegetation type. Predominate species include tulip poplar, red maple, American beech, hemlock, etc. The leaf litter present in this area was relatively light; the lack of fuel contributing to the *lack of significant fire behavior* in this fuel type.

Weather

One of the primary difficulties associated with an assessment of the Marvin Fire is the lack of on-site weather data. Weather is the most variable and, in many cases, the most dominant among those factors that influence fire behavior from among the "big three" (fuels, weather, topography). Ideally, fire weather data would be available on-site for the entire duration of a fire incident. The lack of availability of on-site weather taken during the active phase(s) of the Marvin fire makes it more difficult to accurately assess overall fire behavior at the fire site. Never-the-less, reasonable assumptions about weather can be made by interpolating data from other nearby sites. Weather data was used from four sources when conducting this assessment of the Marvin Fire:

- Fire Weather Forecast for Buchanan County VA issued by the National Weather Service Office Charleston, WVA, 1502 Friday, November 11, 2005 and 0415 Saturday, November 12, 2005.

- Weather for Richlands, VA (approximately 15.6 driving miles form Marvin Fire site), archived from the Weather Underground Website, for Saturday, November 12, 2005.
- Weather from the Lonesome Pine Airport (Weather Station ID KLNP), Wise, VA, November 12, 2005, 1300, located approximately 61 driving miles form the Marvin Fire site.
- National Fire Danger Rating Station (NFDRS) weather and indices from Remote Automated Weather Station (RAWS) located at Wise, VA, U.S. Forest Service, Station 448502CLN, located approximately 65.4 driving miles from the Marvin Fire site.

It should be noted that NFDRS indices taken from the Wise RAWS site (along with five other stations scattered throughout the state) are intended to predict general fire behavior over a fairly wide geographical range. Outputs are used when making decisions regarding a wide range of fire management activities including managing initial attack resources on portions of the George Washington/ Jefferson National Forest and surrounding lands.

Weather data was interpolated from the four sources already described in an attempt to arrive at a reasonable assumption of what weather factors probably were present on the site of the Marvin Fire at 1300 hours on Saturday, November 12th, 2005. Actual weather readings were within the parameters of the fire weather forecast issued by the National Weather Service for the Buchanan County area on the date of the fire. In addition, several indicators of drought were evident in the area of the fire and undoubtedly contributed to significant fire behavior. These were:

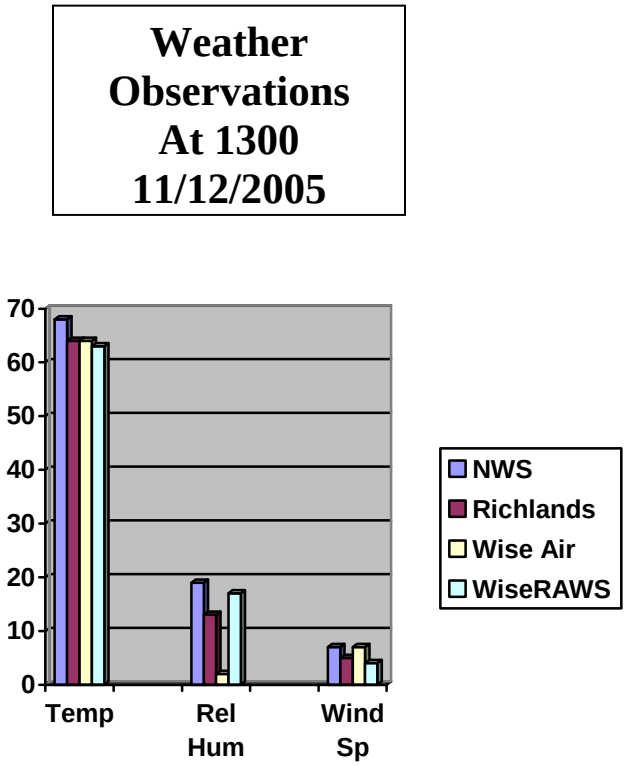
- The Keetch-Byram Drought Index (KBDI), an indicator of sub-surface moisture, was 502 for the date of the fire (at the Wise RAWS station). In a "normal" year the KBDI would likely be 50-100.
- The Virginia State Climatological Office listed the area (Buchanan County), in which the Marvin Fire was located, as having a precipitation level of between 50-75% of normal (9/1/2005-11/30/2005)
- The Palmer Drought Index for the area was -2.0 to -2.9 (moderate drought).
- The U.S. Drought Monitor (November 1, 2005) listed the area of the State of Virginia where the fire occurred as being in a type D1 (first level) to D2 (Severe) drought status.

Weather Comparison

Site	Dry Bulb Temp	RH%	WS	WD
Wise RAWS	**63**	**17**	**4**	**270 (W)**
Wise (Airport)	**64**	**2**	**7**	**180(S)**
NWS Fire Weather Forecast	**68**	**19**	**3-7**	**190(SSW)**
Richlands VA	**64**	**13**	**5**	**Variable**

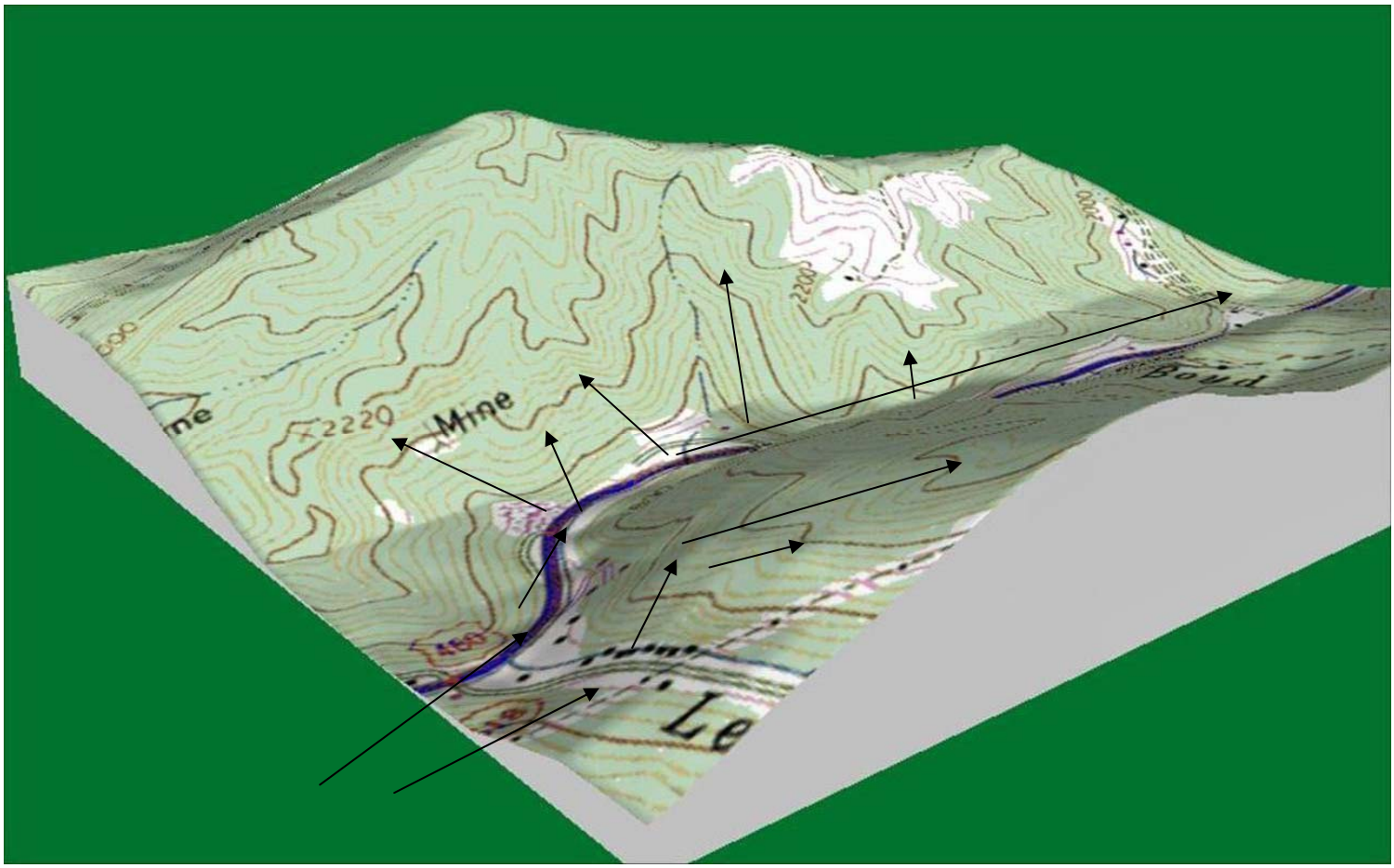
In written narratives, Scott Ward and David Richert, VA department of Forestry Employees who were dispatched to the Marvin fire later in the day of November 12, 2005, reported gusty winds and spotting of the fire caused by winds. Although their observations were mainly centered around fire events after 1440 hours on

the date in question, they lend credence to the fact that wind apparently played a significant role in contributing to the behavior (rates of spread, growth of fire perimeter, and ground spotting) of the Marvin fire earlier in the day, though perhaps not as much as was evident later in the day. In addition to the wind speeds and direction noted above, two additional factors exacerbated the wind speeds already in evidence at the time of the fire. By late morning (approximately 1000-1100) upslope winds would have started to be present in the area of the fire. The topography of the area was the major contributing factor to these upslope winds. The shape of the land was also a contributing factor. The Marvin Fire was located on the upper section of a large up-valley topographical configuration culminating at the summit of Shortt Gap (figure 4). During the day, especially on days in which differential heating patterns caused by topography and the natural tendencies of warm air to rise are present, up-valley winds are produced which can be expected to reach up to the 10-15 mph range, *not including* wind speeds already present. In addition to the up-valley winds, more topographically specific up-slope winds occur in areas where steep canyons or "hollows" are present. These landforms act as natural funneling agents for warm air that seeks to rise and finds itself channeled between steep slopes on several sides, much in the same way that a chimney creates a draft on a woodstove. Winds produced in this manner can be expected to rise at between 3-8 miles per hour *exclusive* of any other winds already present. At the site where the Marvin Fire started, all three of these factors were present: general winds of 3-7 mph; upslope winds of 3-8; and up-valley winds of 10-15 mph. It is likely that these three winds combined; acting synergistically to create 20-foot winds in the 16-30 miles per hour range at various times during the duration of the fire. Since vegetation can serve as an agent to reduce or even block the effects of wind, especially in areas where large trees and/ or forests predominate, a wind reduction factor should be included as a part of the assessment of winds at the fire scene. The Fire Behavior Prediction System (BEHAVE) used in this analysis provides a wind reduction factor of 0.4 to account for the reduction of wind by standing trees and forested areas. After this computation the final wind speeds at the fire site were likely in the 6-12 mile per hour range, with gusts occurring at twice that rate.



Effects of Up-valley and Up-slope Winds

Figure 4



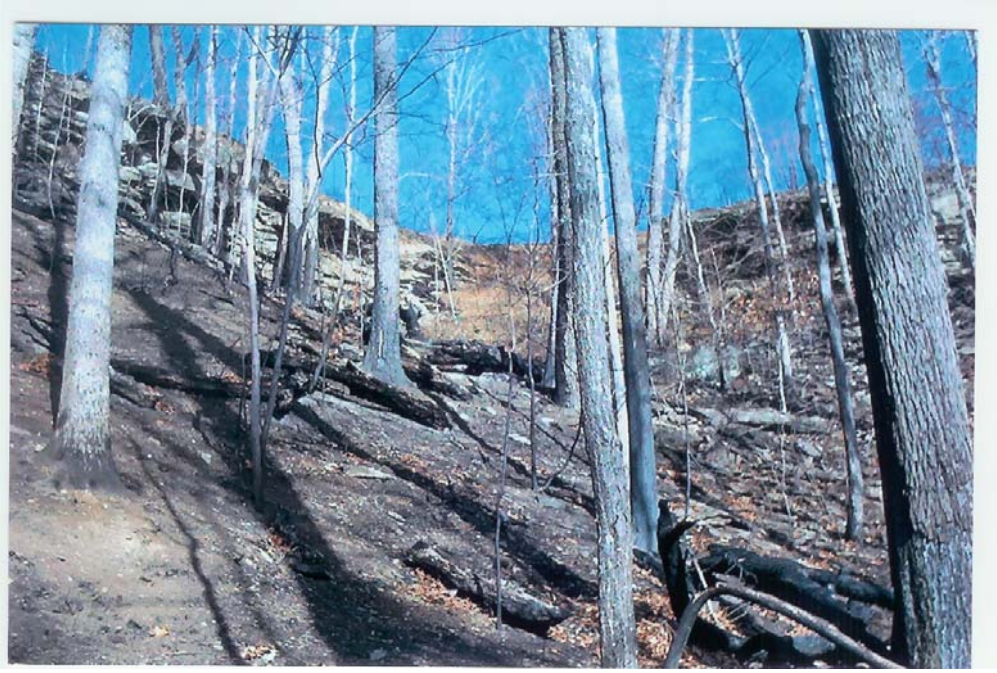
The weather was to have been characterized by the presence of high pressure and a fairly stable atmosphere, neither of which is necessarily an indicator of large-fire growth. The Haines Index was also a 4 (low) which is a further indicator of relative stability in the atmosphere. The atmosphere in the fire assessment area appears to have become less stable later in the afternoon after 1700.

Topography

The topography at the Marvin Fire is characterized by the predominance of steep terrain. At the ignition point of the fire, and in the area where the fatality occurred, slopes were 47-50%, steep, and rocky. The base elevation change from the ignition point of the fire to the top of the ridge just above where the victim was found was 600 vertical feet; with a horizontal distance of 1200 feet. In the area located just above residence #2 (figure 6), the terrain was slightly less steep and averaged 33%. As can be seen in figure 4 above, the terrain was cut by numerous steep canyons or “hollows”. These natural chimneys provided a natural avenue for wind to travel upslope at faster rates than if the terrain were flat. Fire naturally channels into these areas and travels rapidly uphill assisted by the wind. In addition, the ridge top located immediately above the victim was configured as a

saddle, that is, a middle area of low ground surrounded by higher ground on either side (figure 5). Saddles channel wind (and fire) through the center of this type of terrain largely due to the compression and “funneling” effect of wind between the higher ground on either side of the low point. The history of wildland fire fighting fatalities involving this particular type of terrain feature is significant. Many fatalities have been shown to have been the result of situations where steep canyons and saddles served as precipitating factors in creating conditions where extreme fire behavior was the end result.

Figure 5



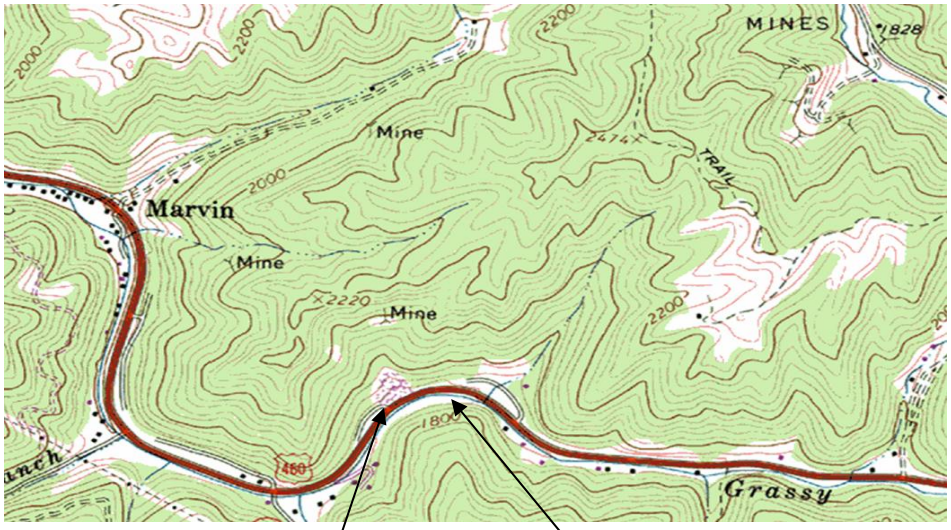
One of the primary functions of terrain in a wildland fire event is directly related to the effect of slope on fire behavior. Fire can spread significantly faster on a steep slope than on level terrain in the same fuels. Flame lengths will also be greater on steep terrain. Both wind and slope tilt flames over the unburned fuels and bring them to ignition temperature sooner than if they were not present. This causes faster spread rates and longer flame lengths, both of which have negative impacts upon suppression resources. As was discussed earlier, slopes in the section of the Marvin Fire where initial attack activities were undertaken range from 33% on the lower end of the unit to 50% near the summit. The presence of chimneys and saddles exacerbated the negative effects of fire in many areas of the Marvin Fire as has already been discussed.

In areas where steep terrain is present, as on the Marvin Fire assessment area, significant variations in temperature and relative humidity occur in valley bottoms, on mid-slopes, and on upper slopes and ridgelines. These variations in slope contribute to differences in both temperature and relative humidity. Cumulatively, these effects create differences in fuel types, fuel loadings, and fuel moistures. As a result, they have a direct impact on fire behavior, particularly as it relates to fireline intensity and rates of spread. Statistically, fires that start at the base of a slope (such as the Marvin Fire) become the largest fires. Because fire spreads best uphill,

once the fire at the base of the hill gains momentum in its upward movement, the availability of large quantities of fuel (both in terms of total area available and density) enables the fire to reach a greater size.

The aspect (the direction that a slope is facing) of the Marvin Fire also contributed significantly to fire behavior by providing opportunities whereby fuels received more direct heating (from the sun), and therefore possessed lower fuel moistures (caused by lower humidity and higher temperatures) than in other areas. The south and southeast aspects of the Marvin Fire assessment provided those aspect conditions considered to be most favorable for fire start and spread.

Figure 6



Other Factors

Several other factors contributed to wildland fire behavior at the Marvin Fire assessment. At the approximate time of the fire start (believed to be approximately 1100-1200), the probability of ignition (defined as the probability that a firebrand would land in a receptive fuel bed and start a new fire and/ or add to present fire behavior) at the fire site was from 70-90% based upon the following fine fuel moistures:

- Fine Fuel Moisture- 2 Probability of Ignition 90%
- Fine Fuel Moisture- 3 Probability of Ignition 80%
- Fine Fuel Moisture- 4 Probability of Ignition 70%
- Fine Fuel Moisture- 5 Probability of Ignition 70%

All of these represent significant probabilities of ignition that contributed to the initial fire start as well as influencing subsequent fire behavior primarily through ground spotting and the ignition of new fires ahead of the advancing main fire.

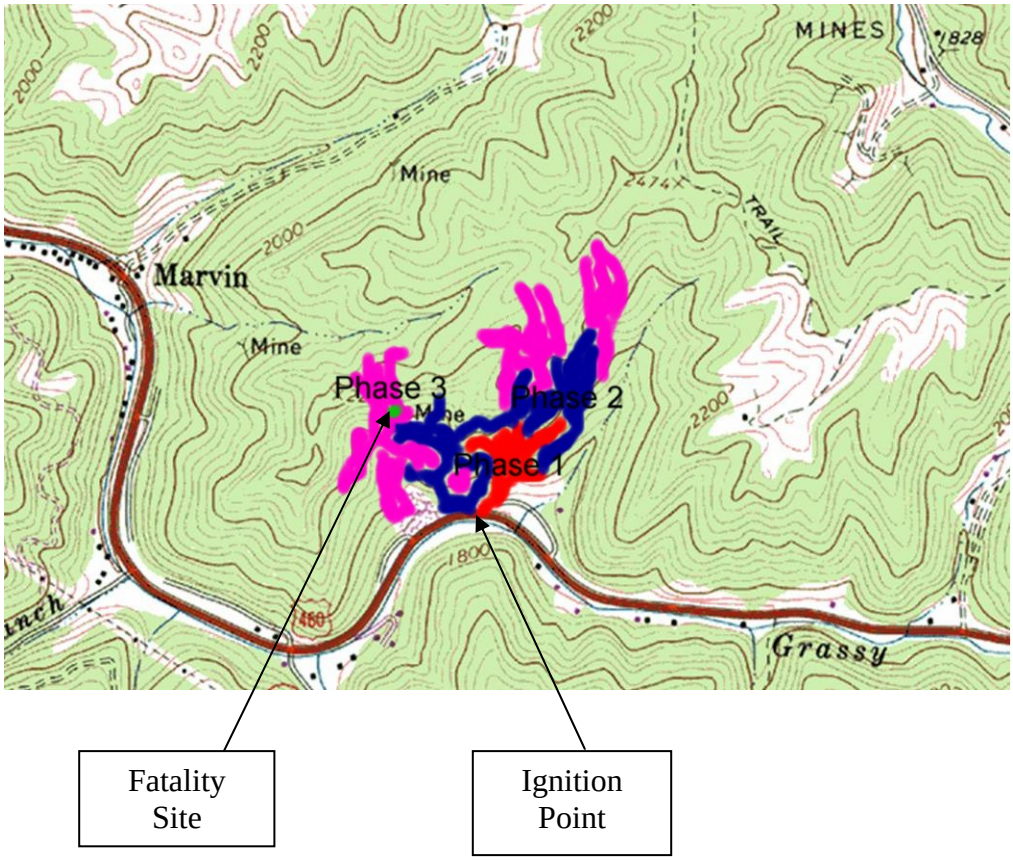
The presence of several old logging grades (see figure 7) in the assessment area were responsible for two changes in forward spread of the fire. First, they tended to act as a barrier to fire movement, slowing down the forward rate of spread of the fire, largely by providing an area of flat ground and more sparse fuels. Secondly, they caused the head of the fire to move laterally until such time as either spotting occurred across the grade or the fire was able to traverse the grade laterally to an area where it was narrow enough to move into receptive fuels on the slopes above. Once the fire crossed across the barrier(s) provided by the logging grades, it again commenced making rapid uphill runs with characteristic increased fire spread towards the summit of the assessment area. These logging grades are not shown on any of the maps of the assessment area, though it is thought that Chief Willard would have known of their existence.

Figure 7

Fire Behavior Assessment

Conditions for very active wildland fire behavior were in place by 1100-1200 on November 12, 2005 at the location of the Marvin Fire in Buchanan County, Virginia. The area was in extended drought (KBDI 502, Keetch-Byram Drought Index, Palmer Drought Index); fine fuels were in abundance on the ground and were very dry (fine fuel moistures between 2%-4%) and "fluffy" having just fallen from the deciduous trees that dominate the assessment area; temperatures (mid 60's) were unseasonably warm for the time of the year (November); relative humidity was *very* low (2-19%; 15% average); winds in the assessment area, though not considered extreme in their intensity, were considerable when combined with low relative humidity, steep terrain at the assessment site, the synergistic effect of mid-day upslope winds, up valley winds, the presence of steep canyons, chimney's, saddles, a south-southeast aspect; southerly wind direction upslope, etc.
Forward rates of spread (ROS) from the point of ignition were between 11 and 52 chains (1 chain = 66 ft) per hour, with 21 chains per hour being the probable average ROS. Average flame lengths were between 3.4 and 7.6 feet. These figures *may be understated* since fire behavior models generally do *not* accurately predict rates of spread caused by the spotting that results from blowing leaves (ground spotting). Lower flame lengths were probably only in evidence at the lower elevations during the first few minutes of the fire. Within a short period of time, the fire started to travel upslope at increased rates of spread, primarily due to the effects of terrain slope and upslope winds and their effects on the head of the fire. Phase 1 on figure 8 depicts the fire spread from the point of ignition based upon the fuel, weather, and topography factors already discussed in this assessment. Note that in Phase 1 the fire moved uphill at approximately 220 degrees (measured clockwise from uphill) at rapid rates of spread noted above. At this point the fire was *not* moving directly uphill towards the area where the fatality occurred. Instead, it was traveling directly uphill from the ignition point into an area of very steep terrain. However, at the same time, the flank of the fire was beginning to move laterally to the west and was slowly working its way towards steeper terrain and more abundant fine fuels before beginning its uphill run. (Phase 2). As was discussed earlier, it is likely that the presence of old logging grades in the area may have retarded the uphill advance of the fire to the west. The elapsed time for phase 1 was likely between 45 minutes to 1 hour. Phase 2 spread began at 45-60 minutes> and continued until 1 to 1 ½ hours had elapsed. At that point Phase 3 began, where side-hill fire movement on the west flank (almost directly below where the victim was ultimately found) was quickly beginning to convert into strong and rapid uphill runs at rates of spread (ROS) likely exceeding 29 chains per hour. Smoke production was likely very heavy during this phase of the fire and may have been a contributing factor in the fatality. The entire ridgeline located above the fatality site would have been completely engulfed in heavy smoke with visibility and oxygen availability being reduced to an absolute minimum level.

Figure 8



The head of the fire reached the fatality site between 2 -2 ½ hours (likely at approximately 1330-1400) after the initial ignition of the fire along Highway 460. It is important to note that the effects of heavy smoke and heat from the head of the fire would have had a significant impact on the area where the fatality occurred, perhaps as much as 15-20 minutes prior to the arrival of the head of the fire. Once the fire funneled through the saddle located just above the fatality site, it moved into areas where heavier fuels and brush were present on the ridge top. In addition, the fire continued to move laterally on both flanks until it was able to acquire favorable terrain and fuels, resulting in strong uphill runs towards the ridge tops all along the spreading flanks of the fire.

- At the completion of Phase 1 the fire was approximately 10-20 acres in size.
- At the completion of Phase 2 the fire was approximately 41 acres in size
- At the completion of Phase 3 the fire was approximately 92+ acres in size.

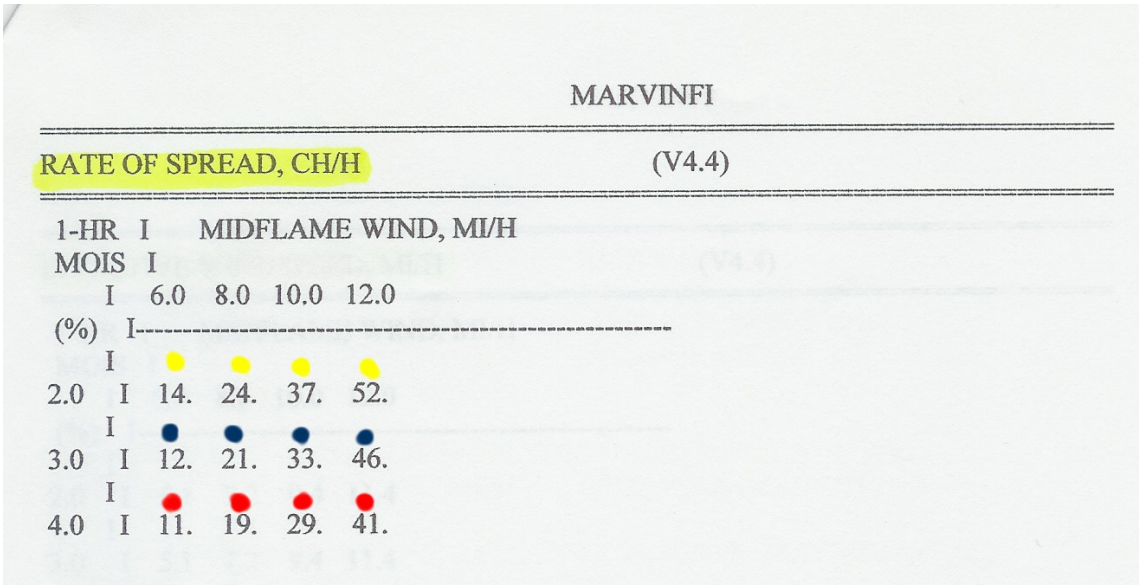
Rapid rates of spread at the head and on the flanks of the fire were exacerbated by ground spotting, a particular problem in fine, fluffy fuels like hardwood leaf litter, where gusty winds in steep terrain spread burning leaves readily into unburned fuels adjacent to the head and flanks of the fire. Based upon the fire behavior likely to have been occurring at the head of the fire, spotting may have occurred ahead of the main head of the fire as far as .2 mile.

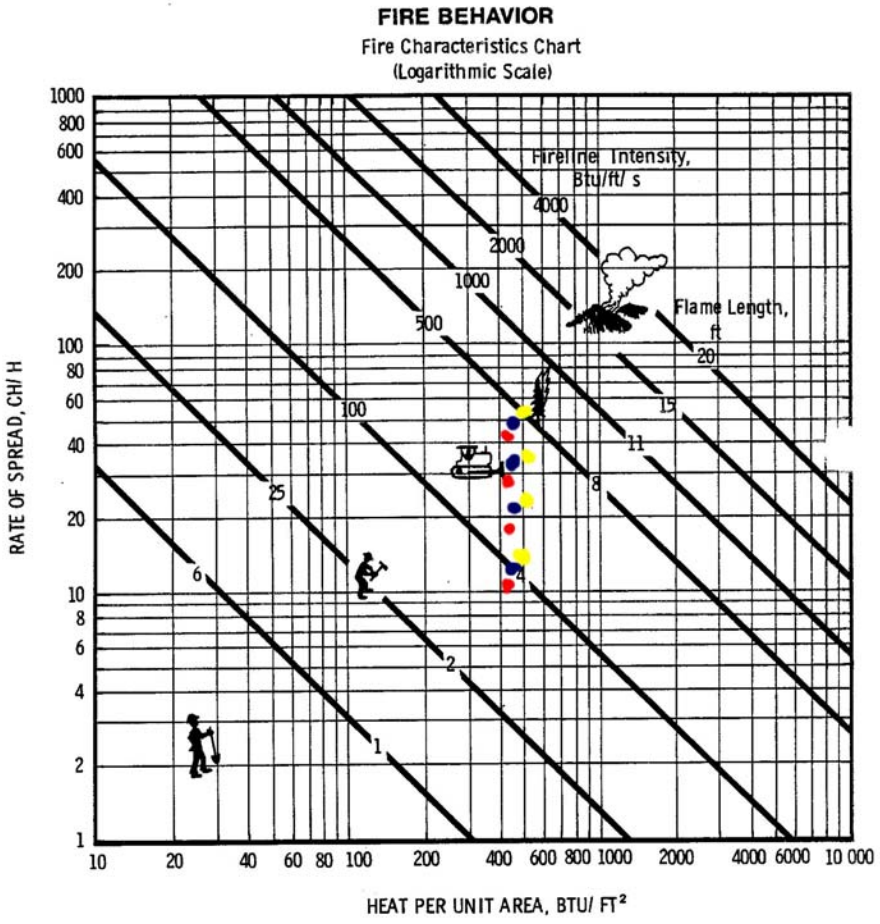
Conclusions regarding fuels and fire behavior on the Marvin Fire

In situations where fire behavior exceeds expectations, close analysis generally points directly to factors that combine synergistically to create those conditions. The Marvin Fire was no exception. More than a few of the factors related to wildland fire behavior were outside the range of values expected in a "normal" fire situation for this geographic area at this time of the year. As was discussed earlier, temperatures and relative humidifies were far above the range of normal values expected. When combined with significant drought, steep terrain, dry, "fluffy" fuels, the presence of steep chutes, box canyons, saddles, and the presence of upslope and up valley winds, fire behavior parameters could be expected to be above the range of what would be considered "normal". By the same token, while resultant fire behavior at the Marvin Fire was outside "normal" ranges, it should not be considered extreme from a fire behavior standpoint. Had winds been significantly higher in velocity and the atmosphere more unstable, fire behavior would likely have been more severe than was experienced. At the assessment site, fuel loadings were relatively light. Had there been excessive loadings of heavier fuels, the resistance to control of the fire could have been more severe. Never-the-less, rates of spread and flame lengths produced at the Marvin Fire assessment site precluded the use of direct attack by hand crews in all but 1 of 12 fuel moisture/ wind scenarios (see figure 9), effectively limiting suppression efforts by the small number of initial attack resources available to fight the fire. Fire behavior at the fire site is best summarized as exhibiting the following characteristics:

- All sources of ignition were dangerous
- Aggressive burning conditions were present
- Spot fires occurred often and spread rapidly
- Extreme fire behavior was *possible* (though not necessarily present at all sections of the fire)
- Favorable burning conditions for fire spread were present
- Rapid uphill runs in fine fuels occurred regularly, especially when aided by wind and terrain
- **Flame lengths and fireline intensity would have made direct attack by available suppression resources untenable in the majority of the assessment area.**

Figure 9





References

This assessment was prepared by Douglas G. Raeburn of Raeburn Environmental Services, Luray, Virginia. (Biography attached).

CONCLUSION

The incident review team concludes that the entrapment and fatality on the Marvin Fire resulted from the interaction of steep terrain, light flashy fuels, intense fire behavior and the failure to follow LCES guidelines during initial attack operations. This resulted in a rapidly spreading, high intensity fire that engulfed one firefighter during the initial stage of an incident.

RECOMMENDATIONS

The following recommendations address the direct causal factors of the fire entrapment. The incident review team recommends the following:

1. The Department of Forestry increase the frequency and number of local volunteer fire department trainings - with an emphasis on fire suppression tactics and safety - including LCES and the 18 watch-out situations.
2. The Department of Forestry switches to regionally specific radio programming, rather than a single statewide standard, to allow the incorporation of more local VFD and cooperator radio frequencies to provide better incident communications.
3. The Department of Forestry must work in Unified Command with the Chief or other officer in charge where Fire Departments have jurisdictional responsibility for the protection of structures. This will emphasize the safety of all firefighters and the public, ensure coordination of objectives, and maximize communications between the DOF and Fire Departments.

Findings

S: Significantly Contributed **I: Influenced** **D: Did Not Contribute**

	1. Fuels
I	Fuel Model 9 (Hardwood Litter)
S	**Heavy layer of leaf litter**
S	**Light Flashy Fuels, fine fuel moisture between 2% and 4%**
	2. Weather
S	**Relative humidity was estimated to be 15 percent @ 1300 hours**
I	Wind Speeds 6 to 12 mph with gusts to 24 mph
S	**Keetch-Byrum Drought Index (KBDI) was 502**
I	Class 3 day (of 5).
	3. Environmental Factors:
S	**The terrain was steep and mountainous.**
S	**Slope ranged from 47% to 50%**
S	**The fatality occurred in a drainage that leads to a saddle.**
I	Time of day when fatality occurred.
I	Smoke in the area.

	4. <u>Incident Management:</u>
I	Instructions were clearly understood by all members of the fire department.
D	The fire department members respected and worked well with their supervisor.
I	The Chief of the fire department did not have adequate communications with other members of the fire department.
S	The L.C.E.S (Lookouts, Communications, Escape Routes and Safety Zones) concept was not followed adequately by the Chief.
D	The Chief of the VFD had 25 years experience as a firefighter.
	5. <u>Equipment</u>
I	The victim was not wearing full personal protective equipment (PPE).
I	No portable radio was carried by the victim. There was no communication link between the chief and other members of the fire department.
I	The victim was not carrying a fire shelter. (Time for deployment of a shelter was insufficient to be a viable alternative.)

APPENDIX A
***Designates those that apply to this incident.**

WATCH OUT SITUATIONS

1. Fire not scouted and sized up.
2. In Country Not Seen in Daylight.
***3. Safety Zones and Escape Routes Not Identified.**
***4. Unfamiliar with Weather and Local Factors Influencing Fire Behavior.**
***5. Uninformed on Strategy, Tactics and Hazards.**
6. Instructions and Assignments Not Clear.
***7. No Communication Link with Crew Members/Supervisor.**
8. Constructing fire line Without Safe Anchor Point.
9. Building fire line downhill with fire below.
10. Attempting a Frontal Assault on the Fire.
***11. Unburned Fuel Between You and the Fire.**
12. Cannot See Main Fire, Not in Contact with Anyone Who Can.
***13. On A Hillside Where Rolling Material Can Ignite Fuel Below**.
***14. Weather is Hotter and Getting Drier.**
***15. Wind Increases and/or Changes Direction.**
16. Getting Frequent Spot Fires Across Line.
***17. Terrain and Fuels Make Escape to Safety Zones Difficult.**
18. Taking a Nap Near the Fire line.

STANDARD FIRE ORDERS*

Fire Behavior:
***1. Keep informed on fire weather conditions and forecasts.**
***2. Know what your fire is doing at all times.**
***3. Base all actions on current and expected behavior of the fire.**

Fireline Safety:
***4. Identify escape routes and make them known.**
***5. Post lookouts when there is possible danger.**
6. Be alert. Keep calm. Think clearly. Act decisively.

Organizational Control:
***7. Maintain prompt communications with your forces, your supervisor, and adjoining forces.**
8. Give clear instructions and ensure they are understood.
9. Maintain control of your forces at all times.

If 1-9 are considered, then:
***10. Fight fire aggressively, having provided for safety first.**

Common Denominators of Tragedies on Fires*

1. Occurred on relatively small fires or isolated sections of larger ones.
2. Happened during flare-ups in deceptively light fuels.
***3. Happened when fires ran uphill in chimneys, gullies, and steep slopes.**
4. Occurred from unexpected blowups of "innocent" appearing fires.
5. Some suppression tools, such as helicopters or air tankers, can adversely affect fire behavior. The blasts of air from low flying helicopters and air tankers have been known to cause flare-ups.

*Designates those that apply to this incident.

Downhill Checklist

Downhill fire line construction is hazardous in steep terrain, fast-burning fuels, or rapidly changing weather. Downhill fireline construction should not be attempted unless there is no tactical alternative. When building downhill fireline, the following is required:

1. Crew supervisor(s) and fireline overhead will discuss assignments prior to committing crew(s). Responsible overhead individual will stay with job until completed (TFLD or ICT4 qualified or better).
2. Decisions will be made after proposed fireline has been scouted by supervisor(s) of involved crew(s).
3. L.C.E.S. will be coordinated for all personnel involved.
    - Crew supervisor(s) is in direct contact with lookout who can see the fire.
    - Communication is established between all crews.
    - Rapid access to safety zone(s) in case fire crosses below crew(s).

4. Direct attack will be used whenever possible, if not possible, the fireline should be completed between anchor points before being fired out.

5. Fireline will not lie in or adjacent to chute or chimney.

6. Starting point will be anchored for crew(s) building down from the top.

7. Bottom of the fire will be monitored: if the potential exist for the fire to spread, action will be taken to secure the fire edge.